

The extent and nature of the commercial captive lion industry in the Free State province, South Africa

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Abstract

The captive breeding of wildlife for commercial purposes is a controversial issue. In South Africa, the farming of African lions (*Panthera leo*) for commercial trade emerged in the early 1990s, partly as a conservation measure to reduce the decline in wild lion numbers while meeting increasing wildlife trade demands. In May 2021, the South African Department of Forestry, Fisheries, and the Environment (DFFE) announced plans to end the captive breeding of lions, keeping of lions in captivity, and the use of captive lions, their parts and derivatives for commercial trade. Here, we examined the commercial captive lion industry from 2017 to 2020 in the Free State province, the heart of the lion breeding industry. We document the extent of the industry and highlight a number of key management issues. Of particular concern were issues with microchip numbers, which are used to follow each registered lion from birth to death through the system and to avoid laundering of wild caught and/or non-registered lions. Of the 4,823 unique microchips that were identified, at least 11% could not be followed through the system. Additionally, a minimum of 199 microchip numbers may have been reused by permit holders, either on captivity, euthanasia, or transport permits, indicating potential non-compliance with the Threatened or Protected Species (TOPS) Regulations. We highlight further areas of concern that warrant additional attention for these types of activities that may cause management issues during the transition period and which may also be relevant for the keeping, breeding, and trading of other TOPS regulated species in South Africa, particularly big cat species.

Keywords

animal welfare, commercial captive breeding, conservation, *Panthera leo*, traditional Chinese medicine, wildlife trade

Introduction

The captive breeding of wildlife for commercial trade is a controversial issue. By some actors, it is considered to be a useful conservation tool that could potentially take pressure off threatened and/or protected free ranging wildlife populations, allowing legal trade to continue in captive-bred wildlife while maintaining local livelihoods and national economies (Jepson and Ladle 2009; Challender and MacMillan 2014). However, for others, it raises ethical and animal welfare concerns when the sole purpose of breeding wildlife in captivity is for their value as commercial commodities (e.g., Schroeder 2018). Further exacerbating the issue is that the presumed effectiveness of commercial captive breeding programmes is based on the conviction that it will reduce poaching and drive illegal wildlife products off the market. A growing body of evidence reveals this is perhaps rarely the case (e.g., Tensen 2016). For example, animals that are taken from the wild can be fraudulently claimed to be of captive-bred origin to circumvent international and national laws restricting the harvest and trade in protected species, e.g., reptiles (Lyons and Natusch 2011; Nijman and Shepherd 2015), tigers (Musing 2020), or bears (Willcox et al. 2016; Livingstone et al. 2018). Where this type of fraudulent activity occurs, it can undermine effective conservation and enforcement efforts and lead to over-harvesting, large-scale illegal trade and loss of community benefits derived from genuine conservation projects, creating a false sense of sustainability (High-Level Panel Report 2020). It may also stimulate demand for wildlife products which may otherwise be reduced (Tensen 2016). To prove the captive-bred origin and prevent the laundering of wild caught animals as captive-bred, different systems are being employed. Depending on the taxon or species, age of the animal and/or the legal situation in the country of origin, microchips, (bird) rings, DNA or photographic evidence may be required to further prove that an animal is captive-bred and ensure its legal origin. Despite these efforts, the laundering of wild caught animals as captive-bred is widespread and occurs globally (Nijman and Shepherd 2015; Musing 2020; Fonseca et al. 2021).

In South Africa, the farming of African lions (*Panthera leo*) for commercial trade emerged in the early 1990s, partly as a conservation measure to reduce the decline in wild lion numbers while meeting increasing wildlife trade demands (Schroeder 2018; Williams and 't Sas-Rolfes 2019). Listed as Vulnerable on the IUCN Red List of Threatened Species, the main threats to wild lions are prey depletion, loss and fragmentation of suitable habitat, human-wildlife conflict, illegal and unsustainable wildlife trade and trophy hunting (Bauer et al. 2016). Lion farming was seen as a way to mitigate these threats but has since drawn widespread criticism as lions are bred purely for: (1) the captive (“canned”) hunting industry in South Africa, where captive-bred lions are released into a confined space from which they cannot escape to be killed for

sport (Schroeder 2018; Green et al. 2021); (2) the traditional medicine trade, where lions are killed for their bones, claws, skeletons, skulls, etc. that are used in a variety of treatments (Williams et al. 2017); (3) the trophy trade where lion parts are considered luxury goods (Williams et al. 2017); and (4) the tourism industry, where lions, especially cubs, are exploited in petting zoos and voluntourism attractions (Schroeder 2018; Green et al. 2021). In May 2021, the South African Department of Forestry, Fisheries, and the Environment (DFFE) announced plans to end the captive breeding of lions, keeping of lions in captivity, and the use of captive lions, their parts and derivatives for commercial trade (Creedy 2021). This decision was based on recommendations by the High-Level Panel (HLP), an advisory panel consisting of individuals from government agencies, conservation and welfare organisations, legal practices, hunting associations, as well as local chiefs and community leaders, appointed to review 'policies, legislation and practices on the management, breeding, hunting, trade and handling of lions, elephants, leopards and rhinos' (High-Level Panel Report 2020). Recent studies highlighting the negative impacts that the commercial captive lion industry has on the conservation of wild lions, habitats, ecotourism, welfare of captive lions, public health and reputation of South Africa as a leader in conservation and ecotourism, were part of this decision-making process (see Schroeder (2018), Green et al. (2020), High-Level Panel Report (2020), and Green et al. (2021) for more details). Furthermore, current captive breeding practices (e.g., inbreeding, crossbreeding/genetic manipulation) and habituation to people preclude these animals from being released into the wild, thereby rendering the industry of little conservation value (High-Level Panel Report 2020). There are also concerns that the commercial breeding of lions for the traditional medicine trade may be stimulating demand and exacerbating the illicit trade of tigers and other big cat species (Williams et al. 2015a, b; Coals et al. 2020).

A successful and responsible phase out of the commercial captive lion industry in South Africa will face a number of management challenges (Green et al. 2021). For example, in its current state, the lion farming industry is governed by a patchwork of contrasting legislation (pertaining to captive breeding, trading, hunting, and keeping of lions) across multiple provincial and national authorities, with disparities and legal loopholes, which create opportunity for harmful and fraudulent activity (Williams et al. 2015a; Wilson 2019; Green et al. 2021). In the absence of a full national audit, the scope and scale of the commercial captive predator industry is largely unknown and publicly available information is lacking (Harvey 2020; Green et al. 2021). Due to concurrent national and provincial jurisdiction resulting from the 9+1 system (Agjee et al. 2018), the issuing of permits exists at a provincial level without a national centralised database to accommodate oversight and record keeping, such as studbooks, veterinary records, lion farm registers, employment records and other financial data, which impedes the ability of relevant authorities to implement and enforce regulations appropriately (Wilson 2019; High-Level Panel Report 2020; Green et al. 2021).

Historically, the Free State province has been described as a key source and exporter of captive-bred lions, with 161 known Threatened or Protected Species (TOPS) registered captive predator breeding facilities holding a total of 3,784 lions at the end of 2016 (excluding hunting and keeping facilities) (Williams and 't Sas-Rolfes 2019).

The Free State has also been considered as being placed at the heart of the captive lion breeding industry in South Africa following the first reports of a permit issued to export lion bones internationally under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which was granted to a breeder in the Free State in 2008 (Williams et al. 2017). The subsequent growth of the industry led to the Free State having the highest number of lions in captivity and becoming the main province to issue CITES export permits for lion skeletons from 2008–2015 (Williams et al. 2017).

Lion farming in the Free State is reported to predominantly revolve around breeding and keeping of lions for both tourism activities and trade rather than the captive hunting of lions (Williams and 't Sas-Rolfes 2019). This is most likely due to provincial regulations prohibiting the breeding and hunting of lions within the same property and stipulating that hunting camps must be larger than 1,000 ha with a maximum of 10 lions allowed per 1,000 ha camp at a time (Williams and 't Sas-Rolfes 2019). This focus on breeding means that facilities in the Free State generally have more breeding lionesses than other provinces and constitute approximately 45% of all captive breeding facilities across the country, selling live lions across South Africa predominantly for the hunting industry (Williams and 't Sas-Rolfes 2019). The Free State is also thought to play an essential role in the euthanasia of lions to feed the lion bone trade to Southeast Asia, including euthanising lions on behalf of farmers in the neighbouring North West province where euthanasia is prohibited (Williams and 't Sas-Rolfes 2019). Despite this, the full role that the Free State plays in the keeping and trading of captive lions has not yet been documented.

Consequently, to obtain a comprehensive insight into the captive lion industry in this particular province, our aim was to: (1) assess the extent and characteristics of the commercial captive lion industry in the Free State, using official records provided by the Free State Department of Small Business Development, Tourism and Environmental Affairs (DESTEA) in response to Promotion of Access to Information Act (PAIA) requests; (2) identify any potential management challenges that might need to be addressed as part of a successful transition away from this type of wildlife trade activity; and (3) in light of available information, propose specific actions that could be taken to help inform a responsible, sustainable, and just transition away from the commercial captive lion industry in South Africa.

Legal framework

International

South Africa is a signatory to the Convention on Biological Diversity (CBD), the Southern African Development Community (SADC) Protocol on Wildlife Conservation and Law Enforcement and CITES. CITES is the main regulatory mechanism governing the commercial international trade in certain wildlife species, including lions, their body parts, and derivatives (CITES 2022). Under CITES, (African) lions

are listed in Appendix II (Species+ 2022). At the 2016 CITES Conference of the Parties, it was agreed that South Africa would be permitted to export lion skeletons, bones, skulls, bone products, claws and teeth for commercial purposes, provided they are sourced from the captive-bred population only. Annual export quotas were to be determined by the DFFE and reported to the CITES Secretariat annually. In 2017 an annual export quota of 800 skeletons was established. This was temporarily increased to 1,500 in June 2018, but was then reduced back to 800 in December 2018, due in part to international criticism. Following a High Court ruling (Centre for Environmental Rights 2019) in August 2019, the setting of the 2019 CITES lion bone export quota was deferred (South African National Assembly 2020) and therefore the quota has essentially been zero in the subsequent years.

National

Several legislative regulatory mechanisms apply to all activities involving lions on a national basis in South Africa. The National Environmental Management and Biodiversity Act (NEMBA) (Act No 10 of 2004) is South Africa's main biodiversity conservation statute. Under NEMBA, lions are listed as Vulnerable and thereby any restricted activity (e.g., hunting, breeding, killing, transport, export, etc.) pertaining to lions falls under a permitting system. This permitting system is regulated under the TOPS Regulations of 2007 and encompasses the registration of captive breeding operations, hunting operations and provides for the prohibition of particular restricted activities. According to the TOPS Regulations, provincial departments responsible for the conservation of biodiversity in each province may exercise the duty of the permit issuing authority, which in the Free State is DESTEA. South Africa's provincial approach to the management and regulation of breeding, trading, hunting, and keeping of captive lions has been criticised as a patchwork of contrasting legislation that creates legal loopholes and the opportunity for harmful and fraudulent activity (Williams et al. 2015a; Wilson 2019; High-Level Panel Report 2020).

The TOPS Regulations must be read in conjunction with applicable provincial legislation that are ultimately subservient to national legislation. The Free State has three main provincial statutes governing the captive lion industry: (1) the Free State Nature Conservation Ordinance Act No 8 of 1969, (2) the Qua Qua Nature Conservation Act No 5 of 1976, and (3) the Nature Conservation Regulations of 1983. These regulations stipulate among other things that registration certificates and studbooks are required, that the minimum enclosure size is 5,000 m² per lion, and that changes in captive predator numbers due to breeding or death are to be reported to the provincial authority within 5 working days. They also stipulate that lion breeding and hunting cannot take place on the same property and that the minimum release time of a captive-bred lion before a hunt must be 30 days. All permits in the Free State (including CITES permits) for lions are 'integrated permits', which means that only one permit is required for restricted activities to fulfil the requirements of both provincial and the TOPS Regulations. The integrated permit may be issued in the format of the provincial or the TOPS permits.

Methods

Permit data were obtained following an access to information request in compliance with the Promotion of Access to Information Act (PAIA) No 2 of 2000, submitted to the provincial permit issuing authority of the Free State (DESTEA). A number of individual PAIA requests were submitted to request information on captive lion, tiger (*Panthera tigris*), cheetah (*Acinonyx jubatus*) and other large felid species for a four-year period from 1 January 2017 to 3 September 2020 in regard to issued captivity, hunting, euthanasia, transport and CITES export permits, as well as quantities of those species in the province. Data for transport permits were only received for the period 2018–2020.

The data were manually collated from scanned permits, then curated and analysed in the R software environment, version 4.0.1 (R Core Team 2020). Duplicated entries were identified by comparing permit variables, such as permit number, number of animals, permit holder identity, and date on which the permit was issued. This resulted in the exclusion of three entries from captivity permits and two entries from transport permits from the analysis. The maps were created using the ‘*leaflet*’ (Cheng et al. 2019), ‘*geosphere*’ (Hijmans et al. 2016), and ‘*sp*’ (Pebesma and Bivand 2005; Bivand et al. 2013) packages, while all other figures were created using ‘*ggplot2*’ (Wickham 2016).

We defined the ‘permit holder’ as the individual person registered with the authority to conduct the activities specified on the permit, whereas a ‘facility’ is the place where the animals specified on the permit are located. We note that some facilities are sometimes referred to under different names on the permits and it is thus possible that in a few instances facilities that we captured as ‘two’ may, in fact, be the same facility. Even though we tried to standardise and match the names it is therefore possible that we are slightly overestimating the number of facilities in the Free State. Permit holders, however, were identified via their unique identity numbers on the permits. These were de-identified prior to the analysis to ensure the anonymity of the individuals concerned. We also did not record the exact location of any of the facilities but approximated their location to the nearest city/town they were registered to. We did not differentiate between the different purposes of facilities that were allowed to keep lions in captivity (e.g., keeping them for tourism purposes, breeding them or lion sanctuaries), as this information was not readily available from the permits. There was also no information on the different types of ‘euthanasia’ and for our study we thus defined it to mean both the slaughter of an animal, for example for their bones and other body parts, but also the humane killing of the animal for veterinarian reasons. When analysing the number of TOPS restricted activities that permit holders engaged in, international (CITES) export was excluded as this information was too incomplete.

We could not account for all lion microchip numbers, as these were either: (1) not documented on the permits; (2) illegible on the original permits; (3) were only provided for some of the lions on specific permits (including for example cubs which were already listed on the permits but had not yet been microchipped); or (4) were documented on a separate document which was not received with the rest of the data. To

find potential non-compliance in the use of microchip numbers, these were extracted from each of the original captivity, euthanasia, CITES, and transport permits and compared to find matching (or isolate) microchip numbers across the different permit types to establish whether individual lions could be followed through the system. We flagged instances of potential non-compliance if microchip numbers had not been recorded on a captivity permit, but were found on any of the other different permit types, as all lions are required to be registered in captivity. For the matching of microchip numbers across permit types we did not take the date and location of the animals on the permits into account, and it is therefore possible that we are underestimating the number of microchip numbers that may have been fraudulently used.

We further analysed whether a microchip number had been used more than once within a permit type. For the captivity permits we flagged the potentially fraudulent use of these microchip numbers if the same microchip number had been used more than once on the same permit, but not if they had been used more than once across different captivity permits. For the euthanasia permits, we flagged the use of microchip numbers as potentially fraudulent if they had been used more than once, given that the same lion can only be euthanised once. For the transport permits, we flagged potentially fraudulent use of the microchip numbers if a lion had been imported to or exported from the Free State more than once and no additional import or export was recorded in the meantime. Multiple transfers within the Free State of the same lion and transfer-export combinations were manually checked against the original data (date, owner and origin/destination location of transports) to establish whether this type of transport for the same lions was possible. Transfer-export combinations were flagged as potentially fraudulent if the lion was exported from the Free State before it was transferred within the Free State, and/or if the lion was transferred from one facility to another to then be exported from the original/first facility without there being evidence of it being transferred back to the original facility, and/or if the lion was transferred and sold to another owner, but then exported from the original owner and/or facility. The same applied for multiple transfers within the Free State and these were flagged as potentially fraudulent if the transfer locations and dates did not match; e.g., if a lion was transferred from one farm to another and at a later date transferred again, but from the original farm from which it had already been moved.

Ethical considerations

To ensure data protection and anonymity during the process of data collection, analysis, and reporting, all raw data files have been saved on password-protected computers by members of the research team only. Where any third-party personal information was provided by provincial officials, this was removed or de-identified during the data processing stage to secure anonymity. No personal information was processed or stored in the UK and Canada. All identifiable information has been excluded from reporting. All permit-related data was obtained via the legal public process according to the South African Human Rights Commission (SAHRC) and PAIA guidelines.

Results

From 2017 to 2020, at least 165 individuals were issued with permits to keep wild animals in captivity in 165 facilities across the Free State. These permits were predominantly issued for the keeping of lions, but also included 34 native and 21 non-native wild animal (sub-) species, ten of which (18%) are considered Threatened by the IUCN (see Suppl. material 1: table S1). Caracal (*Caracal caracal*) and serval (*Leptailurus serval*) were the most commonly kept wild species apart from lions, with animals registered to 44 and 43 permit holders respectively, followed by a number of other native and non-native species (Suppl. material 1: table S1).

With regards to lions, there were 141 permit holders that engaged in at least one of four TOPS restricted activities, i.e., keeping in captivity, transport, euthanasia, and hunting. Most permit holders had permits for a single activity (61; 43%) or two activities (60; 43%). At least 20 (14%) permit holders were engaged in three activities which involved captivity, euthanasia and transport. No permit holders held permits for all four restricted activities (Suppl. material 1: table S2). Of all registered individuals, 131 (79%) had permits to keep lions in captivity in 132 different facilities, while 35 individuals had permits to euthanise lions in 33 facilities (Fig. 1).

Captivity

During the study period a minimum of 4,281 individual lions were held in captivity in the Free State, based on the unique microchip numbers and not accounting for up to 943 lions without microchip numbers (see microchip section below). The number of captive lions in the province appears to have been growing until 2019 and decreased in 2020 (Fig. 2). Likewise, the number of permits that were issued decreased substantially in 2020, with only 54 individuals (41%) having obtained permits to hold lions in captivity in that year, compared to almost double the number (101 individuals; 76%) in 2019. In 2018 and 2017 there were 84 (64%) and 51 (39%) permit holders registered respectively.

Of the 131 individuals with permits to keep lions in captivity, 42 (32%) were issued more than one permit in at least one of the four years, with a maximum number of four permits for a single permit holder in 2018. While each permit is valid for one year, it is possible that these additional permits are renewals, e.g., if new lions or other species had arrived at a farm in the same year, or if cubs were born. Across all years, 28 permit holders (21%) had permits to keep lions in captivity in non-consecutive years, e.g., they had a permit for one year, not the subsequent year and then again in the following year (Suppl. material 1: table S3). Of these 28 permit holders, 20 had permits for the same lions in non-consecutive years, meaning that at least 184 lions were kept by these 20 permit holders over a gap year without a permit and thus in non-compliance with the TOPS Regulations.

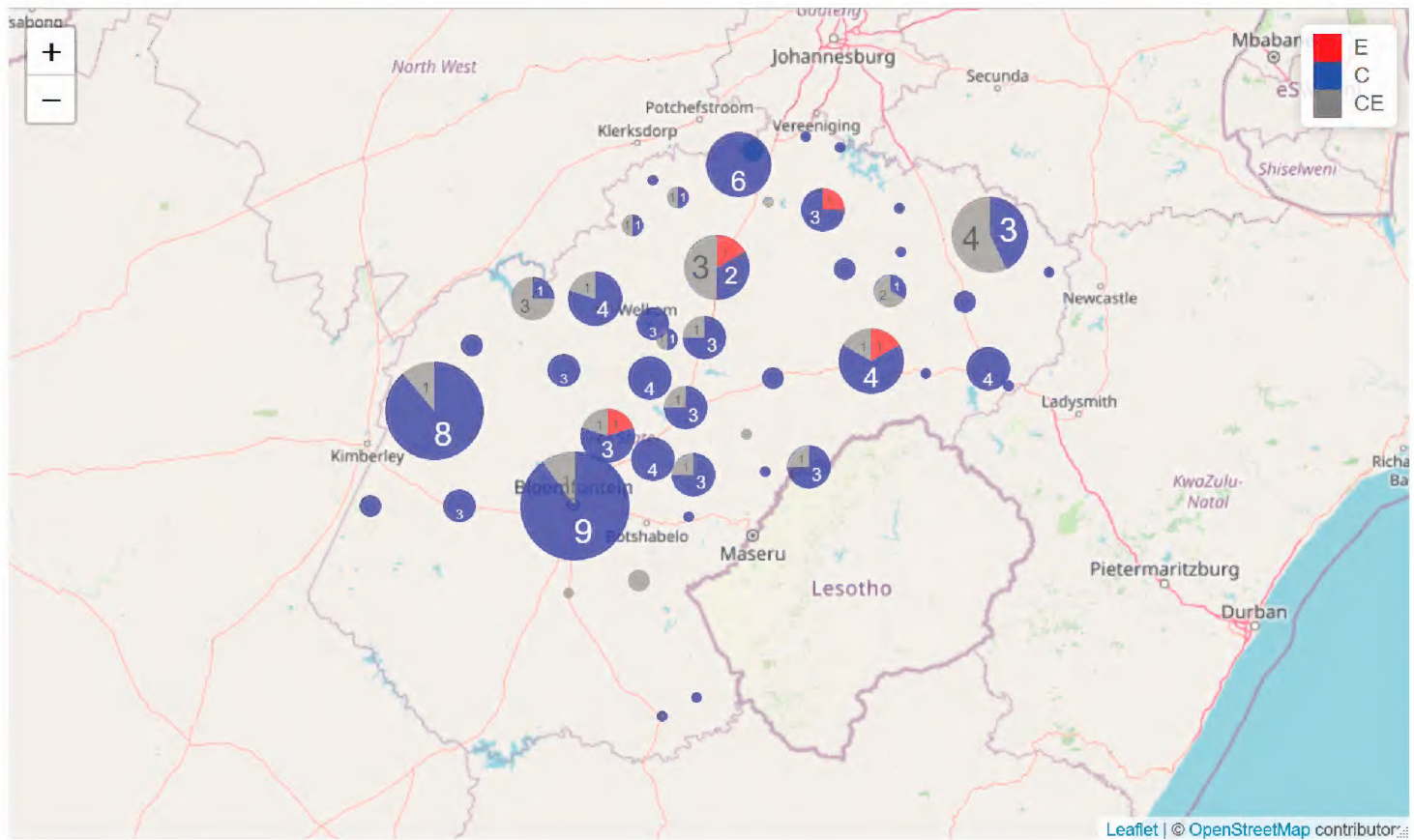


Figure 1. Locations of facilities with permits to either keep lions in captivity (blue), euthanise lions (red), or both (grey). The locations are approximated to the city/town where the facility is registered. The circles are weighted by the total number of facilities per city/town.

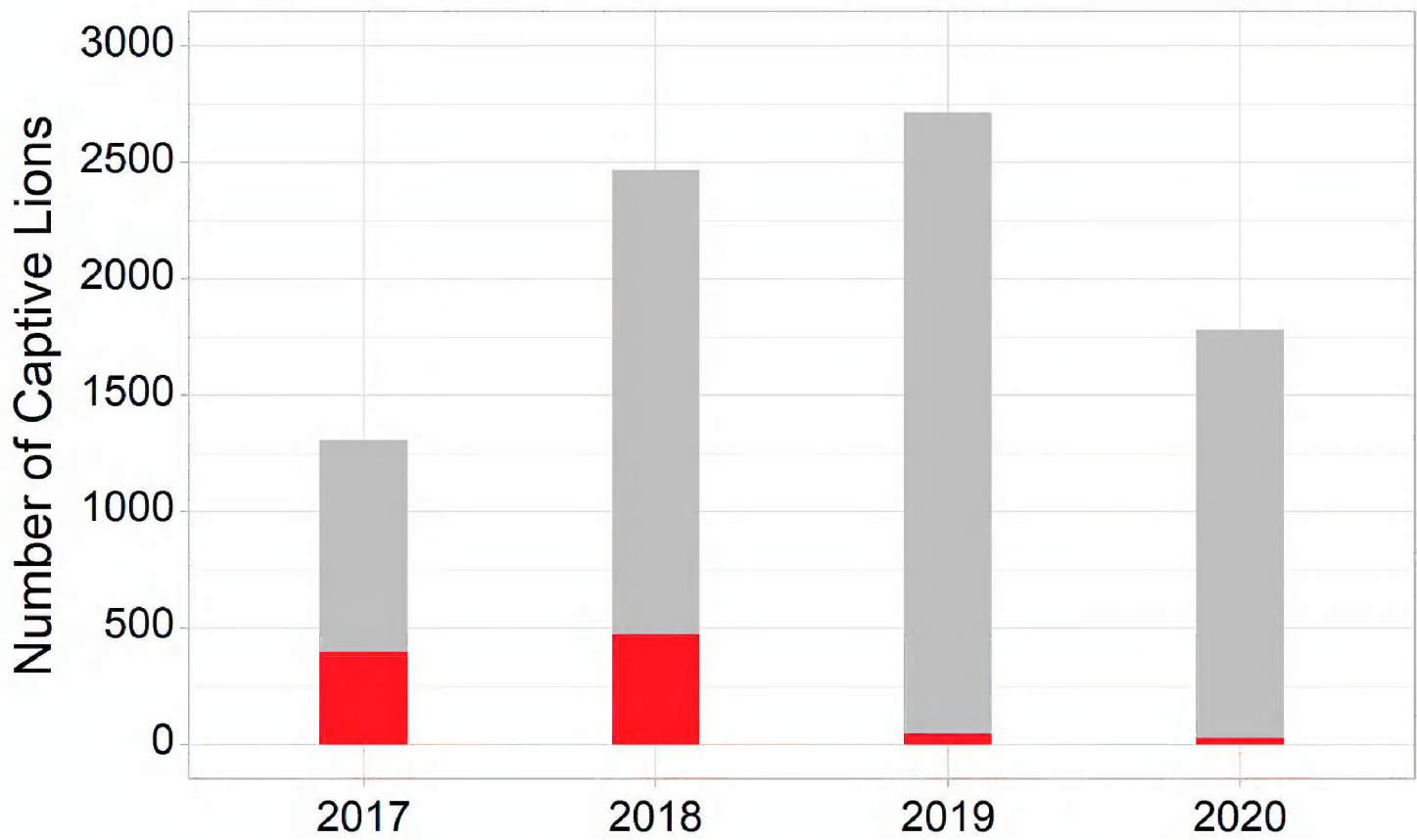


Figure 2. Number of lions in captivity in the Free State, South Africa, from 2017–2020. The numbers are based on the unique microchip numbers of the lions per year (grey) and coloured in red if microchip numbers were not available. Note that the same animals may appear in more than one year, if, for example, permits were renewed.

Euthanasia

Since 2017, 1,087 lions were euthanised in the Free State. Through time, the number of euthanised lions has decreased substantially (Fig. 3).

A total of 35 individuals were issued euthanasia permits between 2017 and 2020. Only one permit holder had more than 30 lions killed in every year between 2017 and 2020, amounting to a total of 235 lions, which accounted for 21.6% of all lions killed during the study period (Fig. 4). Cumulatively, only four permit holders (11%) accounted for almost 50% of all lions killed, and only ten permit holders (29%) for ~80% of all lions killed during the study period (Fig. 4).

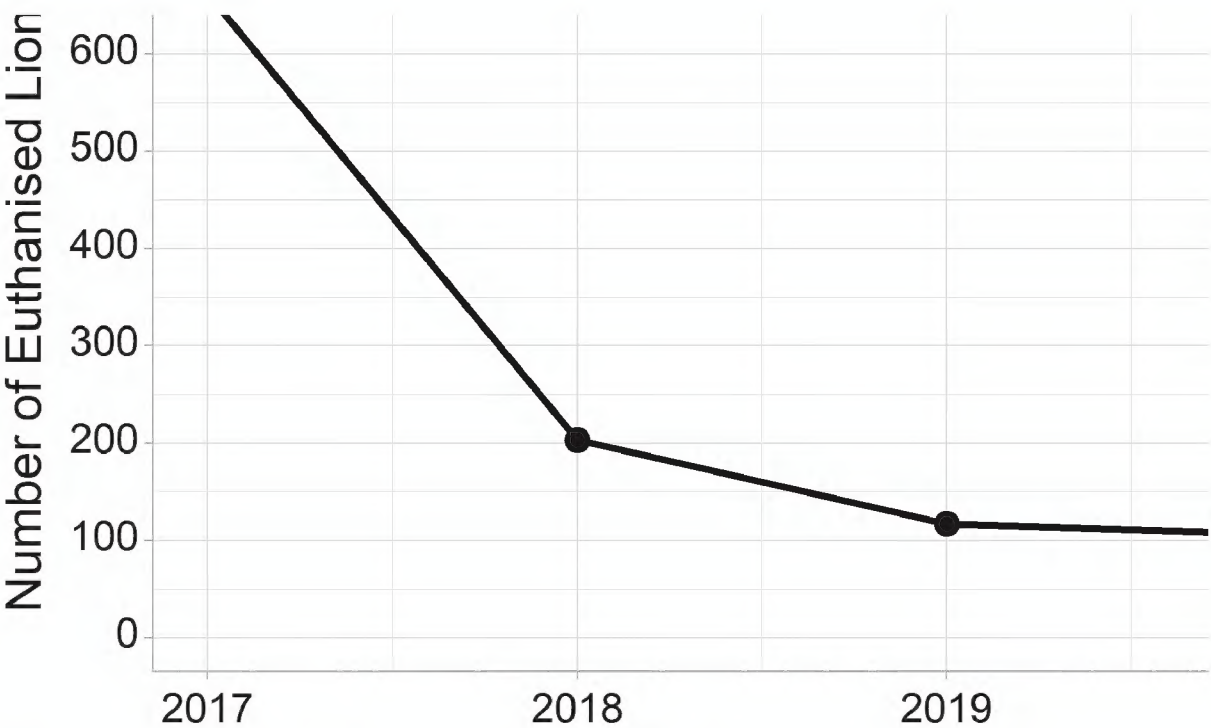


Figure 3. Euthanised lions in the Free State, South Africa, from 2017–2020.

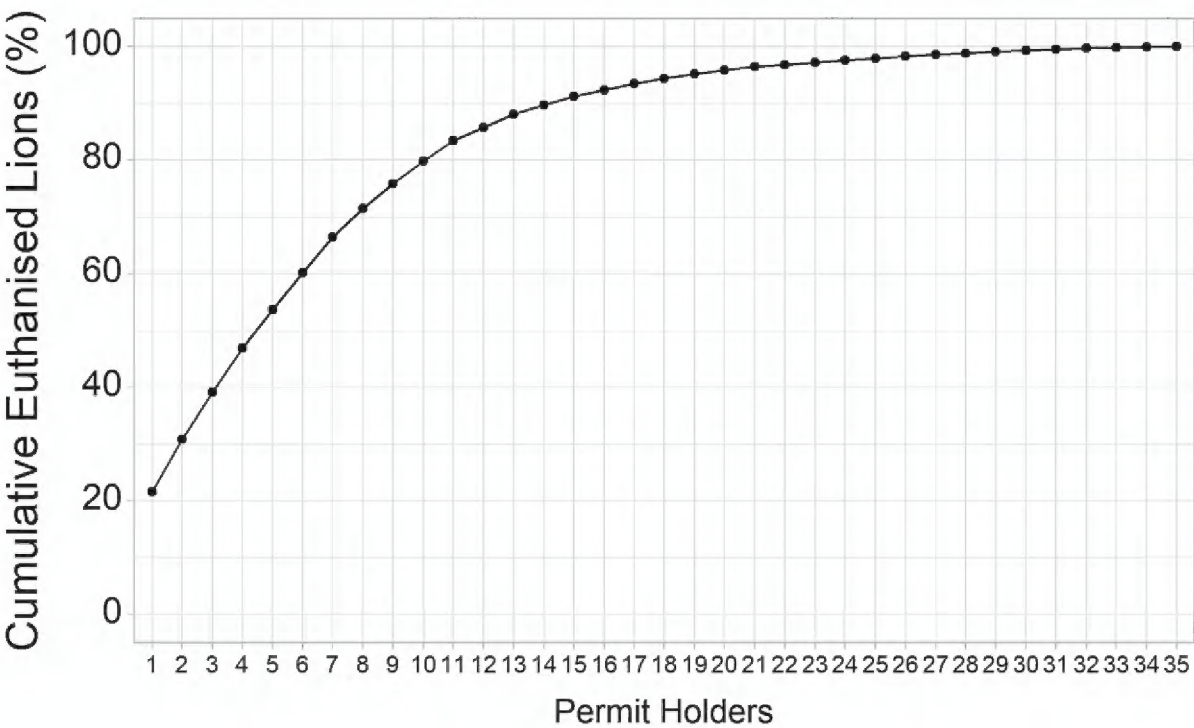


Figure 4. Cumulative percentage of euthanised lions in the Free State, South Africa, from 2017–2020. Each point along the x-axis represents an individual permit holder and their relative contribution to the number of euthanised lions during the study period.

Transport

From 2018 to 2020, a total of 141 transport permits were issued to 65 permit holders for 871 lions to be imported to (24 permits, 182 lions) or exported from (49 permits, 205 lions) the Free State to and from six of the other eight provinces in South Africa. During the same time frame, another 68 permits were issued for 484 lions to be transferred within the Free State province. Most transports were to and from the North West province (Fig. 5). These included 40 exports involving 177 lions exported from the Free State to the North West province, and 14 imports involving 100 lions from the North West to the Free State. The overall number of lion imports decreased through time, while the number of transferred lions as well as the number of exported lions increased from 2018 to 2020 (Suppl. material 1: fig. S1). The different commodities that were transported (e.g., live or dead lions, or parts thereof) were not specified on the permits.

Hunting

From 2017 to 2020, only 18 hunting permits were issued in the Free State for a total of 24 lions. These were issued to 16 individual hunters from the United States of America (USA; 4 permit holders; 25%), Czech Republic (2; 12.5%), Denmark (2; 12.5%), Hungary (2; 12.5%), Slovak Republic (2; 12.5%), Iraq (1; 6.3%), Norway (1; 6.3%), Peru (1; 6.3%), and Ukraine (1; 6.3%). Only three of these hunters directly exported their four lion trophies during the same time period to their home countries (Denmark and Hungary), according to CITES export records.

CITES exports

CITES export records from the Free State revealed that 186 permits were issued for the export of 402 lions and their parts/products from 2017 to 2020 to at least 26 countries worldwide (Fig. 6). The majority of these permits were issued for hunting trophies (82%), which were exported to at least 20 different countries, predominantly in America and Europe (Fig. 6). Live lions were exported to at least seven countries, though this largely involved China (56 lions), followed by the Democratic Republic of the Congo (19) and Saudi Arabia (11). It is noteworthy that all 56 lions exported to China were intended for commercial purposes and were exported from a single owner in the Free State to five importers in China. A minimum of 103 lion skeletons were sent to Vietnam in five instances from two different exporters in the Free State. The majority of these (100 skeletons) went to a single importer in Vietnam during four transactions in 2019.

There were 27 permits for 26 lion trophies and 10 live lions for which no destination country could be identified on the permits. A further two permits for skeletons were issued in 2018, to one exporter, however neither the quantity nor the destination country could be identified on the permits. Notably, 44% of all CITES exports regardless of commodity occurred in 2019 (Suppl. material 1: fig. S2).

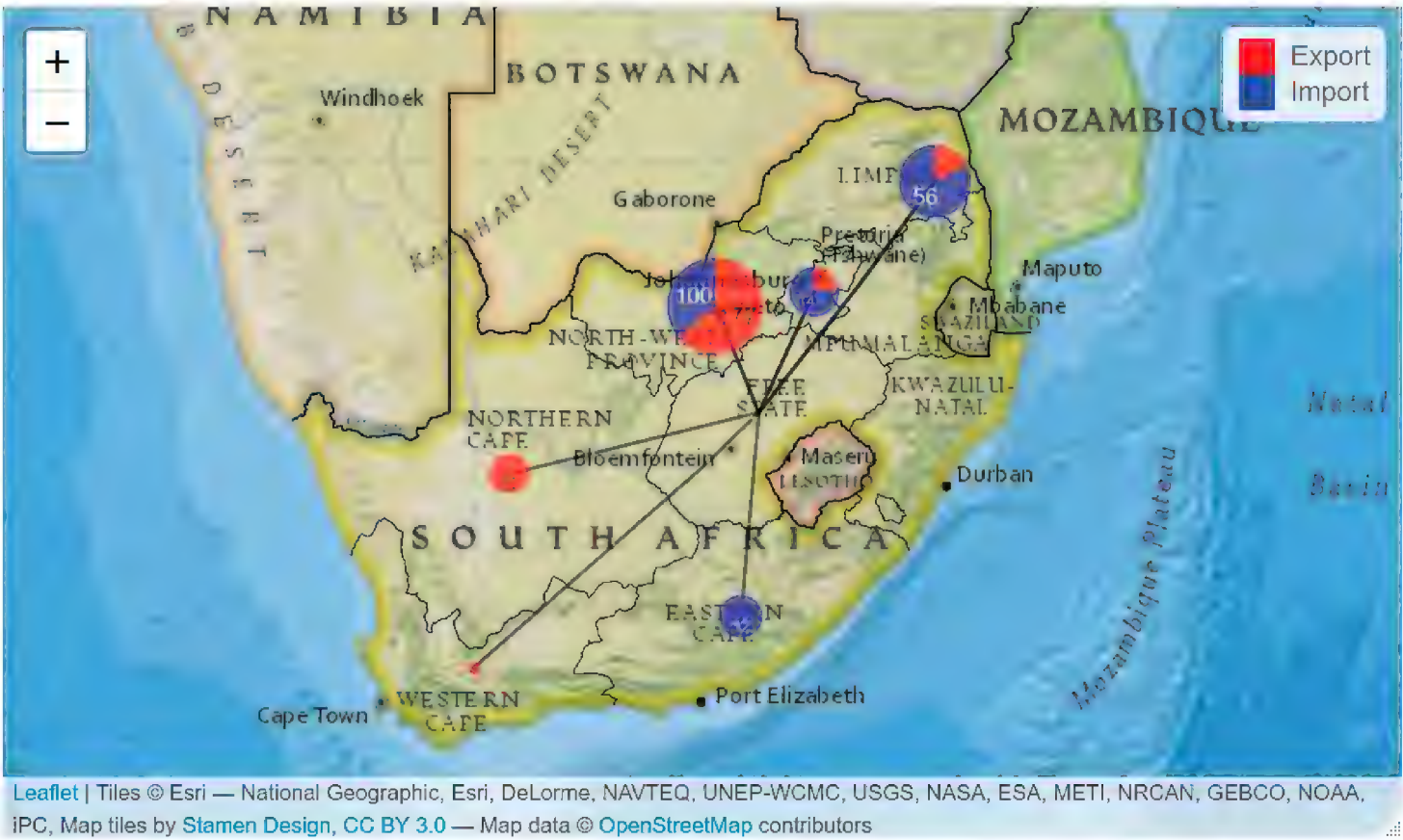


Figure 5. Exports from (red) and imports to (blue) the Free State, South Africa, from 2017–2020, with the circles weighted by the logarithm of the number of lions transported between provinces. The numbers in the pie charts represent the number of transported lions.

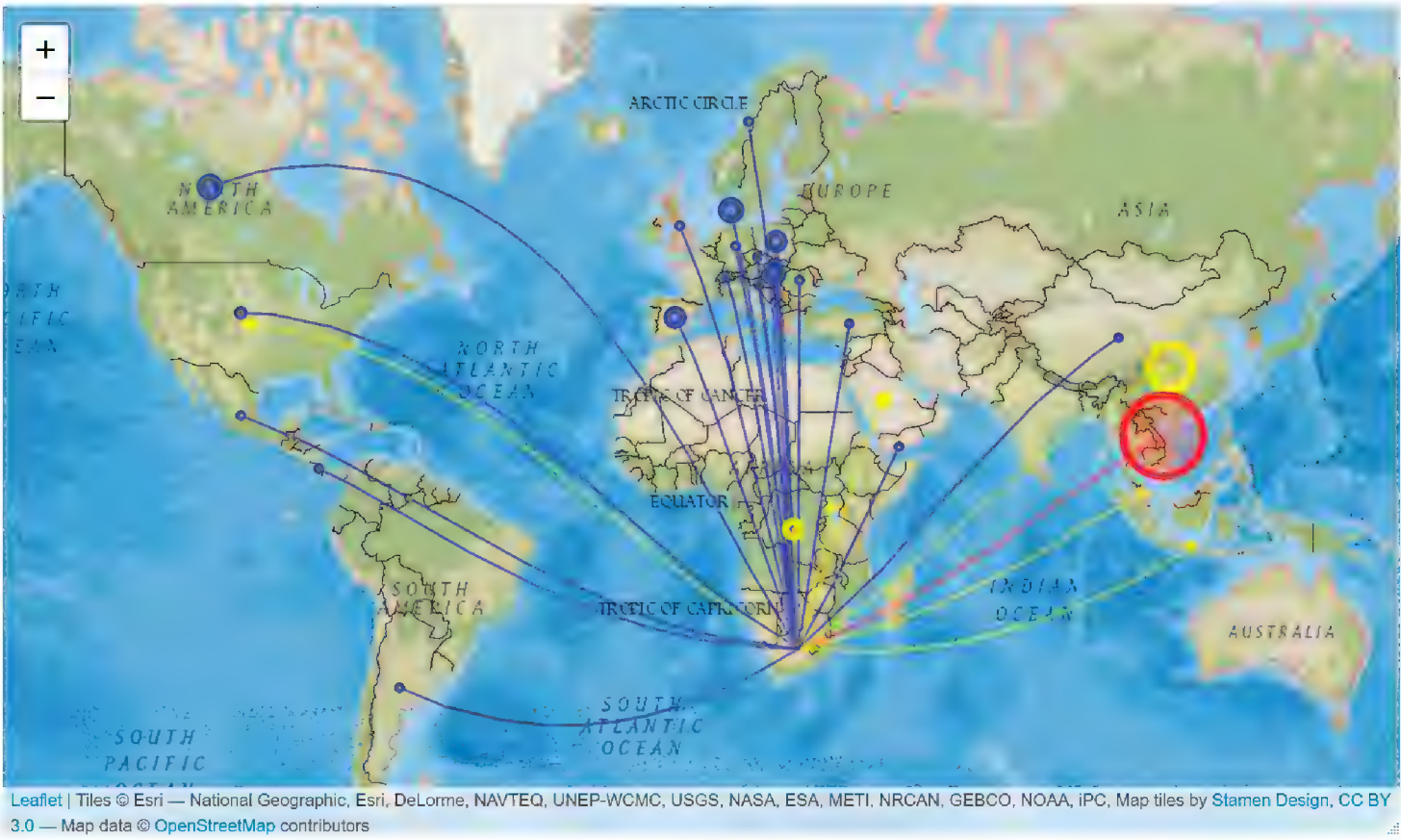


Figure 6. CITES lion exports from the Free State, South Africa, from 2017–2020. Colours indicate the exported commodity (blue = trophies, red = skeletons, yellow = live) while the circles are weighted by the exported volumes per destination country. The markers do not represent specific locations within a country but are approximately centralised. Note that China and the USA were the only countries to receive both trophies and live animals and are thus represented twice on the map. Not included in the map are 25 trophies, two skeletons, and eight live lions for which no destination country could be identified from the permits due to the poor quality of scanned copies provided by DESTEA.

Microchip numbers

At least 4,823 unique microchip numbers were identified across all permit types. Of these, 513 (~ 11%) could not be followed through the system (Fig. 7). We also found irregularities in the re-use of microchip numbers across all permit types indicating potential non-compliance with TOPS permit requirements (Table 1).

Of the 9,504 lions that were recorded on captivity permits through time, 8,561 lions (~ 90%) were listed with a microchip number (Table 1). The total number of

Table 1. Distribution of identified microchip numbers on different permit types (i.e., captivity, euthanasia, and transport) and potential non-compliance to TOPS standard permit conditions in the use of these microchip numbers.

Permit type	Total Number of lions listed on permits	Number of lions identified with a microchip number (%)	Minimum number of potentially fraudulently used microchip numbers of lions identified on permits (% of lions per permit type)	Number of permit holders involved in potentially fraudulent use of microchip numbers (% of permit holders per permit type)
Captivity ¹	9,504	8,561 (90%)	39 (0.4%)	15 (11.5%)
Euthanasia	1,087	747 (69%)	109 (15%)	11 (31%)
Transport	871	870 (100%)	51 (14%)	10 (15%)

Note: 1 The total number of lions recorded on captivity permits does not refer to the total number of unique lions in captivity, as in many cases the same animals (identified by microchip numbers) are listed on more than one captivity permit, in particular when permits are renewed.

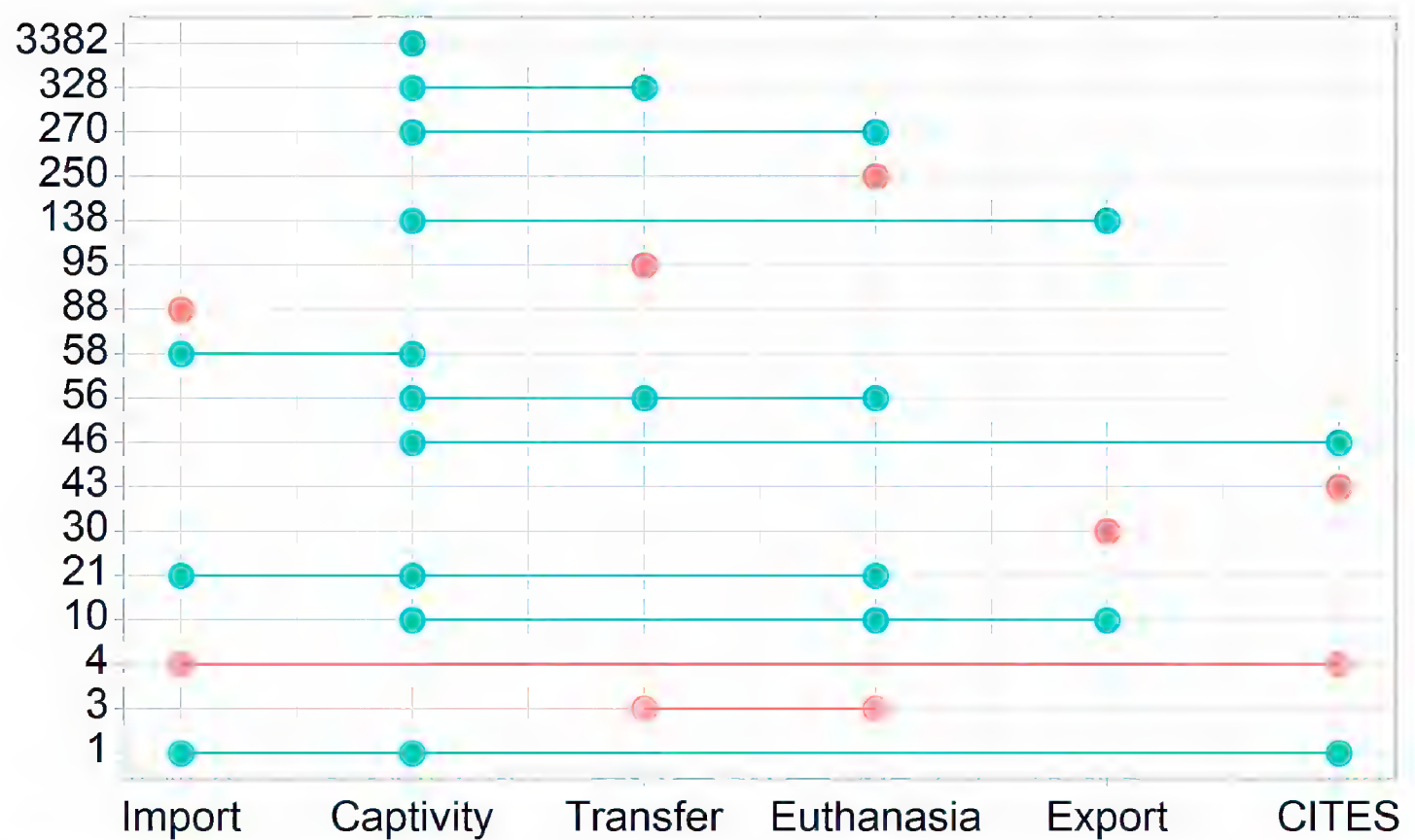


Figure 7. Number of times a microchip number could be followed through the system, where the connecting lines indicate the different permits the same microchip number has been reported on (i.e., import to the Free State, captivity, transfer, euthanasia, export from the Free State, or CITES exports). The numbers on the y-axis indicate the number of times in which the combination has been identified. The colours indicate whether the combination is theoretically possible (blue), or improbable (red).

lions recorded on captivity permits does not refer to the number of individual/unique lions in captivity, as in many cases the same animal is listed on more than one captivity permit, in particular when permits are renewed. Nonetheless, at least 39 microchips had been used twice on the same permit, indicating non-compliance to TOPS permit conditions. These 39 microchip numbers were used on 18 permits registered to 15 different permit holders.

Only 747 (~69%) of the 1,087 lions that were euthanised could be identified via their microchip number. Of these 747 microchip numbers, 109 (~15%) were used more than once. In two cases a microchip number had been used up to four times, in 27 cases three times, and in 80 cases they had been used twice. In total, 11 permit holders reused microchip numbers of lions that had already been euthanised (Table 1). In another two cases a microchip number was used twice on the same permit.

Of the 871 lions that were transported within South Africa (exported from, imported to or transferred within the Free State), 870 (~100%) could be identified via their microchip numbers. Of these, 64 microchip numbers were used twice, and one microchip number was used three times. These ~7.5% of lions could potentially have been moved more than once, e.g., if a lion was imported to the Free State and subsequently moved to a different farm, or if a lion was transferred within the Free State and subsequently exported to another province. However, the records indicate that in 18 cases a lion had been imported or exported to/from the Free State twice without evidence of the animal being exported/imported again in between, thus indicating potential non-compliance. Similar irregularities were observed with the transfer of lions within the Free State and/or subsequent export, representing a total of 33 cases/microchip numbers. We thus conclude that at least 51 microchip numbers (~14% of the 870 identified lions) may have been fraudulently reused by ten different permit holders (Table 1).

Microchip numbers were only provided for two of the 24 hunted lions. Both these microchip numbers had previously also been recorded on captivity permits. For another seven lions it was stated that the microchip numbers would be determined at the hunt, and these were therefore not recorded on the original permits.

None of the microchip numbers that were identified on CITES permits had been reused.

In total, 34 (24%) of 141 permit holders who had engaged in a minimum of one TOPS restricted activity (i.e., captivity, euthanasia, or transport) had reused lion microchip numbers on their permit applications, showing potential non-compliance to the TOPS Regulations.

Discussion

The commercial captive lion industry in the Free State

The Free State province is known for having a high number of lions in captivity compared to other South African provinces (Williams et al. 2017) and the permit data received from the Free State provincial authorities confirms that the number of cap-

tive lions held in the Free State represents more than half of all captive lions held in approximately 350 facilities nationwide (Coals et al. 2020; Hutchinson and Roberts 2020). Our data suggests that captive lion facilities in the Free State keep lions to supply the hunting industry and to a lesser extent the tourism industry in the Free State and in other provinces, and to euthanise lions to export their parts and derivatives for the lion bone trade.

The Free State is one of the few provinces in South Africa that allows the euthanasia of lions with the relevant TOPS permits. Some of the farms involved claim to be sanctuaries or reserves and yet routinely euthanise their lions, presumably to sell and/or export the body parts. One such farm, which was accountable for over 20% of all euthanised lions in the Free State, claims to breed their lions for genetic diversity and fitness for a time when captive lions can be introduced into the wild. Others claim their lions are euthanised to eliminate 'bad genes' (Williams and 't Sas-Rolfes 2019). However, the reintroduction of captive-bred lions into the wild has always been a challenge and there have been no records of success (Hunter et al. 2012). It is therefore unlikely that any captive-bred lions from these farms will ever be reintroduced to the wild or contribute to positive conservation outcomes (Hunter et al. 2012).

The very small number of hunting permits issued in the Free State and the high number of interprovincial transfers from the Free State suggest that hunting predominantly takes place in other South African provinces. This is particularly evidenced by the high transference of lions to the North West province, where facilities are mostly oriented towards hunting (Williams and 't Sas Rolfes 2019) and provincial regulations allow for the shortest minimum release time (96 hours) in South Africa (Williams et al. 2015a; Williams and 't Sas-Rolfes 2019). Furthermore, while CITES export records show that the Free State issued 152 permits for trophies between 2017 and 2020, most of these CITES permits were for lions hunted in other provinces and subsequently transported to taxidermists in the Free State to prepare the trophies for international export.

The number of captive lions as well as permit holders in the Free State increased annually until 2019 before decreasing sharply in 2020. This decrease in our data may be due to the fact that we only received partial data for 2020 (until September), but also in part to the zero export quota for captive-bred lion body parts and derivatives for commercial purposes following the aforementioned High Court ruling in August 2019 (Centre for Environmental Rights 2019). The global COVID-19 pandemic could also have played a role, as the extensive lockdown regulations during 2020 would have impacted on public service duties, such as the issuance and renewal of permits (de Waal et al. in prep). There is no doubt that such external factors will continue to impact the industry. In addition, many provinces in South Africa are reportedly under-resourced and struggle to keep on top of the permit applications (Department of Environmental Affairs 2019; de Waal et al. in prep). A national audit in 2016/2017 showed a high number of facilities continuing to trade with expired permits (Department of Environmental Affairs 2019). It should therefore be noted that a decrease in issued permits and the number of permit holders may not necessarily reflect a lower number of facilities engaging in captive lion keeping. It may simply indicate that fewer facilities are keeping and trading lions legally i.e., with the relevant and valid TOPS permits. Our data

confirms this for the period 2017 to 2020, as we found permit holders keeping the same animals over a year without captivity permits, showing a continuation of keeping and trading without valid TOPS permits.

There was also a decrease in the number of lion imports and euthanised lions in the Free State over the study period. This is in contrast to Williams and 't Sas-Rolfes's (2019) prediction that the number of euthanised lions would increase after trophy import bans were implemented by several countries, as farmers would shift their focus either to selling lion bones or would decrease their stock of lions which were meant for trophy hunting. One reason for this decrease could indeed be the ban on trophy hunting imports that was implemented in 2016 in the USA, the main importer at the time of captive-bred lion trophies from South Africa. It is possible that after the ban, surplus hunting lions were transported to the Free State in 2017 to be euthanised, following which imports to the province subsequently decreased. Unfortunately, we did not receive any transport data for 2017, but the euthanasia data shows that most lions were euthanised in 2017, followed by a sharp decrease in the years thereafter. This decrease is most likely also the result of the zero CITES export quota for lion bones from 2019 onwards when the quota setting process was deferred as a result of the High Court ruling (South African National Assembly 2020), whereas in 2017 and 2018 the CITES export quota for lion skeletons was set at 800 per year (Williams et al. 2021). The lions that were euthanised in 2019 and 2020 most likely became part of a growing and largely unregulated stockpile of lion bones that exists in South Africa, which warrants further investigation. Similarly, the live lion exports may require further investigation, as it is unclear what happens to these animals once they arrive at their destinations. It is possible that some live exports are used to circumvent the CITES quota for lion bone exports and that these animals are euthanised at their import destination to feed the persisting demand for lion bones, particularly in Asia.

Management issues and challenges

A number of key management issues were identified within the commercial captive lion industry that are of regulatory concern (Table 2). One significant and recurring issue identified in our study is the inconsistent, incomplete, and/or unclear record keeping. For example, our results show three CITES permits for lion skeletons issued to one exporter in the Free State in 2018, however neither the quantity of skeletons nor the destination country could be identified from two of the permits. On an additional permit only the destination country (Vietnam) could be identified, but not the quantity of skeletons. Issues with CITES permits for lion bones have previously been detected, e.g., when Vietnam was erroneously reported as a destination country instead of Lao PDR (Williams et al. 2017). Furthermore, the Free State authorities do not appear to keep a complete and accurate list of captive lion facilities in the province, nor do they appear to have accurate records of the number of lions kept in those facilities. The keeping of transparent, centralised baseline information is crucial at the provincial level as South Africa has no overarching national oversight or record keeping (Wilson

2019; Green et al. 2021; de Waal et al. in prep). A lack of clear and consistent records for the industry impedes the ability of the relevant authorities to manage the industry and ensure that it is compliant with existing legislation (Wilson 2019; Green et al. 2021). Electronic record keeping would allow for inconsistencies to be automatically flagged and would thus reduce opportunities for illegal activities and significantly reduce provincial authorities' workloads.

Furthermore, the lack of proper record keeping enables the misuse of microchips that should uniquely identify each captive lion to prevent fraud and laundering. Although microchip numbers were recorded on most permits received (with few exceptions), our results show that following lions through the system using the microchip numbers is a challenging task, thus creating an environment for fraudulent activities. For example, the relatively high number of reused microchip numbers on all permit types indicates the potential for the laundering of wild lions and other captive big cat species, such as tigers, which are prohibited from being commercially traded. It also highlights the potential for facilities to deliberately reuse microchip numbers to launder unregistered captive-bred lions, which enables the evasion of standard TOPS regulations. Interestingly, the potential fraudulent use of microchip numbers, as well as the absence of microchip numbers on permits, appears to occur mostly on euthanasia permits, i.e., around the lion bone trade. While the South African eight-step compliance procedure to export lion skeletons internationally appears to be fairly robust, some irregularities have been detected, such as bone mixing or pooling, and mislabelling or Tag swapping as potential sources of error in CITES compliance for lion skeleton exports (Williams et al. 2021). Bone mixing/pooling was identified to likely occur at the origin farm, where skeletons can be stored for long periods of time, often in unorganised stockpiles, where inter-individual mixing may occur. Notwithstanding, it remains a possibility that illicit behaviour may occur prior to euthanasia of the animal, e.g., through reusing microchip numbers, and thus would not be captured in the CITES compliance procedure. This is one way of laundering, for example, unregistered captive-bred lions into the legal trading system. We note that we did not take into account the date and location of the animals on the different permits, and we are therefore likely underestimating the amount of potentially fraudulently used microchip numbers.

The correct identification of captive-bred animals is paramount in ensuring that no wild animals are laundered as captive-bred, which is a common occurrence in the wildlife trade (Nijman and Shepherd 2015; Musing 2020; Fonseca et al. 2021). The use of microchips to identify animals found in the wildlife trade is a well-established technique and is often required by law for many protected wild animal species bred or kept in captivity, as tampering with microchips on the animals themselves is difficult. Yet, this study shows that many cubs born in captivity are not microchipped at birth. Furthermore, the general lack of capacity in terms of financial and human resources in wildlife law enforcement (Bennett 2011) makes it difficult to ensure that targeted and systematic exploitation of the administrative system managing these microchip numbers is detected and counter action taken.

We acknowledge that not all instances of potential non-compliance to TOPS permit conditions are necessarily evidence of illegal activity. For example, data entry errors (by the authorities, permit holders or by ourselves) may have led to some microchip numbers not being captured correctly. We also based our analysis on the assumption that all permits that have been issued were subsequently used, although we acknowledge that this may not always be the case (see also Williams et al. 2015a; Poole and Shepherd 2017; Williams et al. 2017; Robinson and Sinovas 2018). Although some of these inconsistencies in the data may have legitimate explanations, the number of times in which these occurred are worrisome and require further investigation by the authorities. We have summarised the identified key management issues and potential solutions in Table 2.

Ensuring regulatory compliance in all areas of the commercial captive lion industry will be particularly important following the 2021 announcement (Creecy 2021) that the South African government intends to prohibit captive lion breeding and tourism interactions with captive lions, as well as to discontinue issuing permits to new entrants into the industry, effectively ending the commercial captive lion industry in the country (Green et al. 2021). Although we acknowledge the data presented here refers largely to the state of the industry before the High-Level Panel review process, the potential opportunity for fraud and regulatory oversight as shown in the data may

Table 2. Key management issues relating to the commercial captive lion industry in the Free State, South Africa, and potential solutions.

Key management issues	Potential solutions
Microchips cannot be followed through the system and are reused	Electronically store microchips in a database, automatically flag when microchips are missing, duplicated or reused in general and especially on the same permit
Unclear at what age lion cubs need to be microchipped	Better define and re-assess wording of relevant regulations
Facilities operating without valid permits	Increase human and financial resources to ensure the relevant agencies can keep up with permit issuing and renewals
Unable to monitor/regulate new births and deaths of lions	Increase number of inspections of the facilities
Unclear how euthanasia is defined and if it relates to the slaughter of lions irrespective of reason for doing so, i.e., if it involves killing for their bones and/or due to illness	Better define and re-assess wording of relevant regulations
No official database of captive lion facilities in the Free State	Increase human and financial resources to ensure all facilities and number of lions are captured correctly and inspected on a regular basis
Incomplete permit record keeping	Electronically store all permits and ensure all relevant information is filled out and matched with lion microchip numbers
Commodities aren't specified on transport permits	Include the commodity/state of a transported animal on transport permits
No clear regulations around stockpiled lion bones	Require stockpiles to be registered and re-assess wording of relevant regulations. Keep a database of registered stockpiles, including bone quantities etc.
Permits are kept in original (paper) form and are hard to read or incomplete	Store permits electronically in a centralised database that will not save entries unless all details are completed.

highlight areas of potential concern that warrant additional attention. In particular, comprehensive baseline data collection, sustained monitoring and clear record keeping will be imperative to ensure that both national and international regulatory compliance is adhered to and to mitigate the potential for using legal trade for illegal activity, such as the laundering of wild or unregistered lions, or trade in other prohibited big cat species, which has been previously outlined as a concern associated with this industry (Williams et al. 2015a, b) and the wildlife trade in general (Nijman and Shepherd 2015; Musing 2020; Fonseca et al. 2021).

Conclusions

The data received from the Free State provincial authorities through the PAIA process confirm that the Free State plays a pivotal role in South Africa's commercial captive lion industry. In particular, facilities in the province focus on keeping and euthanising lions, as well as transferring the lions to and from other provinces, likely for the purpose of supplying hunting or tourism facilities, and preparing lion parts for export, i.e., taxidermy and skeletons. While it is impossible to ascertain the exact effect of various factors on changes in industry activity over time, a number of external events will all have influenced the operations of the commercial captive lion facilities between 2017 and 2020.

Importantly, our data highlight a number of regulatory concerns, particularly pertaining to the use of microchip numbers indicating potential systematic non-compliance to TOPS permit conditions. Incomplete or unclear records further impede accurate baseline data for the industry. Our study corroborates the findings from de Waal et al. (in prep), who show a lack of provincial capacity and an absence of transparent and consistent record keeping that both impedes the authorities' ability to duly manage the industry and ensure compliance with both national and provincial legislation.

These regulatory concerns may further present potential management challenges that need to be addressed as part of a successful transition away from this type of wildlife trade activity. Although our data captures the state of the industry prior to the announcement that the Minister of the South African Department of Forestry, Fisheries, and the Environment intends to effectively end the commercial captive lion industry, we believe these insights can draw attention to areas of the industry that would benefit from additional attention during the exit transition and which will be essential in effectively monitoring and regulating the commercial captive industry of other TOPS regulated species, particularly big cat species.

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Supplementary material I

Supplementary tables and figures

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Data type: Pdf file.

Explanation note: **table S1**: Other (sub-) species held in captivity in the Free State province, South Africa, in addition to lions, including their IUCN Status (CR = Critically Endangered, EN = Endangered, LC = Least Concern, NT = Near Threatened, VU = Vulnerable) and the number of registered permit holders keeping these (sub-) species in the Free State; **table S2**: Types of TOPS permits per permit holder; **table S3**: Distribution of the number of permit holders who had permits to keep lions in captivity in non-consecutive years; **figure S1**: Transports of lions within, to, and from the Free State province, South Africa, from 2018 to 2020; **figure S2**: Number of CITES exported lion commodities from the Free State province, South Africa, from 2017 to 2020.

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